Bloch Wind Farm

Technical Appendix 9.4: Private Water Supply Risk Assessment

September 2022

Document Number: 1295905

Renewable Energy Systems Limited

Document history

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Issue	Date	Revision Details
A1	23/09/2022	First draft submission
B	27/10/2022	Final

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Contents

1. Introduction

A Private Water Supply Risk Assessment (PWSRA) has been carried out for water supplies that may be affected during the construction and operation of Bloch Wind Farm ("the proposed development").

The proposed development is in Dumfries and Galloway, approximately 5.5km south-west of Langholm in an area of open moorland. A topographic high is reached on the northern boundary of the site at Bloch Hill of 271m Above Ordnance Datum (AOD). The proposed development will consist of the erection, 50-year operation, and subsequent decommissioning of up to 21 wind turbines, with tip heights of up to 230m. The proposed development includes associated wind turbine foundations and transformers, battery storage, hardstand areas for erecting cranes at each wind turbine location, access tracks connecting each wind turbine, underground cables linking the wind turbines to the substation compound and three borrow pit search areas.

The proposed development is situated within the Dumfries and Galloway Council (DGC) council area. This document should be read in conjunction with Chapter 9 of the Environmental Impact Assessment Report (EIA Report).

1.1. Scope

This PWSRA forms a Technical Appendix to Chapter 9: Hydrology, Hydrogeology, Geology and Soil of the EIA Report. The purpose of this assessment is to ascertain the potential risk to the identified private water supplies (PWS) within 3km of the site boundary because of construction and operation of the proposed development. Where appropriate, the assessment will provide recommendations for potential mitigation measures. The assessment will adopt a phased approach evaluating risk through the formulation of a Source-Pathway-Receptor conceptual model.

1.2. Disclaimer

This report has been prepared by Natural Power with all reasonable skill, care and diligence for the Client, for the specific purpose of assessing the risk to PWS posed from the construction and operation of the proposed development.

This report details the findings of the risk assessment considering information provided by DGC, the relevant landowners and PWS users and is therefore, as accurate as this information will allow. This document should be considered live and as such, changes will be made should new information come to light.

Natural Power accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Natural Power beforehand. Any such party relies upon the report at their own risk. Natural Power disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the services.

Owing to the inherent complexity of the subsurface, it is rarely possible to determine the mechanics of any hydrological system with absolute certainty. In this regard, investigations as part of this assessment will strive to determine the circumstance of each supply based on the evidence available to support this assessment. Where uncertainty exists associated with understanding the details of a private water supply or in accurately conceptualising the subsurface, this will be stated and risks and assessment considered appropriately.

Whilst the assessment assesses relative risk, no detailed quantitative risk assessment has been completed.

2. Policy and Guidance Context

Legislation and guidance related to good practice during the construction of onshore wind farms that has been considered in the preparation of this document is provided within Chapter 9 of the EIA Report.

3. Methodology

The PWSRA has been undertaken based on the following methodology:

- Completion of a desktop assessment to put the hydrological and hydrogeological setting of the proposed development into context (available in Chapter 9 of the EIA Report);
- Consultation with DGC and PWS users (where necessary) to confirm the location and nature of each supply;
- Based on the information provided, screening out of supplies that are considered unlikely to be affected by the proposed development and a site visit with selected PWS users to verify the location and nature of their supply;
- Preparing a risk assessment to determine the potential effects of the proposed development on the quality and quantity of the water serving the supply; and
- Identification of any additional measures, that should be included as part of the environmental documentation and risk assessments, to avoid and mitigate against any potential adverse effects resulting from the proposed development.

3.1. Desktop Assessment

The desktop assessment was completed using the following secondary data sources:

- Geological and hydrogeological information obtained from The British Geological Survey[1];
- Monthly precipitation and climate data from The Met Office[2];
- Scotland's Environment[3]; and
- Scottish Environment Protection Agency (SEPA) River Basin Management Plans[4].

Details of the existing site conditions can be found detailed in Section 9.5 of the EIA Report.

3.2. Consultation

Consultation with DGC was undertaken regarding the records held on PWS within a 3km buffer of the site. Following data returns, an initial screening was carried out to determine which properties required direct consultation. This process involved sending residents a letter, questionnaire and map aiming to obtain information regarding their supply:

- The letter explained the nature of the works and the purpose of the assessment;
- The brief questionnaire asked residents to provide details on their supply;
- A map showing the location of the property was also included with residents asked to indicate the location of their supply; and

[1] British Geological Society, Geology of Britain Viewer, At: http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html

[2] Met Office, At: https://www.metoffice.gov.uk/public/weather/climate/gcv3mcrf9

[3] Scotland's Environment, Web Interactive Map, At: https://map.environment.gov.scot/sewebmap/

[4] Scottish Environment Protection Agency, River Basin Management Plans, Web Mapping Application, At: https://informatics.sepa.org.uk/RBMP3/

- The questionnaire also included asking permission for Natural Power to undertake an inspection should further information be needed.

3.3. Screening Assessment

Following receipt of the information provided by the residents in their responses, a screening exercise was completed. This was based on the position of the provided PWS information in relation to the work areas associated with the proposed development.

The screening exercise excluded properties where hydrological or hydrogeological connectivity is inconceivable. These were determined through considering the following;

- Surface water catchment boundaries and channel networks;
- Aquifer properties;
- Properties of the underlying superficial and bedrock geology;
- Dominant land use; and
- Topographical considerations.

3.4. Risk Assessment

A methodology for risk assessment of PWS is contained within the Private Water Supplies Technical Manual[5]. Due to the nature of works being carried out at the proposed development, it is deemed impractical to use the methodologies set out in this guidance. When assessing supply compliance with the PWS regulations listed in Section 2, local authorities are required to consider factors, such as: proximity of the supply to cattle and wildlife, historical and current land use, and historical maintenance carried out on the supply. While such factors are useful for understanding the baseline qualities of a supply, they are inappropriate for determining the risk to the PWS during the construction and operation of the proposed development, which is based on the Source-Pathway-Receptor model.

The methodologies set out are based on Natural Powers experience, however, the guidance has been utilised where possible, when trying to establish the varying factors which influence the baseline conditions of the supplies.

The risk assessment considered the type of hazard associated with the project, release and exposure potential and severity of impact.

The Source-Pathway-Receptor concept model was used as the underlying model to assess the risk posed by the development activities. In this model:

- Source refers to the source of the potential risk hazard (not to be confused with PWS source);
- Receptor refers to anything or anyone that could be adversely affected by the hazard (including the source of water supplying the abstraction and associated infrastructure); and
- Pathway refers to the mechanisms by which the hazard is transmitted to the receptor.

Where hydraulic connectivity or linkage exists between a potential contamination source and the receptor by means of a pathway, then a pollutant linkage and associated risk exists. Where there is no pollutant linkage, there will be no associated risk. For any PWS it must first be established if there is a risk to mitigate and then, if necessary, mitigation measures to reduce the risk introduced.

The risk assessment considers the type of hazard associated with the proposed development, the probability and magnitude of an impact occurring, based on the results of the investigation, and the severity of such an impact based

[5] Drinking Water Quality Regulator for Scotland, Technical Guidance and Information, https://dwqr.scot/private-supply/technical-information/pws-technical-manual/

on a combination of the probability and magnitude values. In addition to contamination, there is also the possibility that supply continuity could be jeopardised through water quantity reduction.

For the purpose of this assessment a generic approach has been adopted and considers the catchment to the water supply as the source of water for the supply, the PWS as the receptor and the natural water environment as the pathway that connects both of these.

In the presence of an identified risk or uncertainty meaning the presence of a potentially unacceptable risk, protection or mitigation should be provided that must ensure the PWS:

- Is adequately preserved in terms of both water flow and water quality; and/or
- Is replaced by an alternative process whereby potable water is made available on a temporary or permanent basis, as appropriate.

3.4.1. Significance Criteria

The potential impact to PWS has been assessed in relation to the probability of an impact occurring on the receiving environment and the receiving environments sensitivity to change.

The probability has been classified as high likelihood, likely, low likelihood or unlikely based on criteria outlined in Table 3.1. The likelihood of any impacts on the quality and quantity of water serving the PWS is influenced by the type of supply and its source abstraction location within the catchment in relation to construction activities.

Table 3.1: Probability of impacts

Probability	Definition
High Likelihood	• There is pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	• There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low Likelihood	• There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place and is less likely in the shorter term.
Unlikely	• There is pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

As outlined above the potential impacts on the PWS have been assessed taking account of the type of supply possible connection to the source through the presence / absence of pollutant linkages. The magnitude of potential change to that supply is defined below in Table 3.2.

Table 3.2: Magnitude of change to PWS

Magnitude	Definition
Major	• Major change to the hydrological/hydrogeological conditions resulting in temporary or permanent change. • Complete disruption to operation of supply, impacting on quality and quantity available, new resource to be identified.
Moderate	• Detectable change to the hydrological/hydrogeological conditions resulting in non-fundamental temporary or permanent change.

Magnitude	Definition
	• Partial disruption to the operation of the supply, impacting on quality and quantity. Potential new supply is required for a temporary period of time.
Minor	• Detectable but minor change to the hydrological/hydrogeological conditions. • Minor degradation in the operation of the supply in terms of quantity and or quality.
Insignificant	• No perceptible change to the hydrological/hydrogeological conditions.

3.4.2. Impact Significance Matrix

The likelihood and magnitude of the potential impacts are combined to define the significance of the impact, as shown in Table 3.3. This table provides a guide to assist in the decision making but should not be considered a substitute for professional judgement and interpretation. In some circumstances, the magnitude of effects may be unclear and professional judgement remains the most effective manner for identifying the potential significance.

The significance of the risk considers the successful implementation of the good practice environmental management practices that will be adopted throughout the works. Should the supply still be considered at risk, further details on specific mitigation and/or monitoring recommendations are provided.

Table 3.3: Combined risk

Probability of Impact	Severity of Impact			
	Major	Moderate	Minor	Insignificant
High Likelihood	Very High	High	Medium	Medium/ Low
Likely	High	Medium	Medium/ Low	Low
Low Likelihood	Medium	Medium/ Low	Low	Negligible
Unlikely	Medium/ Low	Low	Negligible	Negligible

The risk categories are further defined in Table 3.4.

Table 3.4: Risk definitions

Term	Definition
Very High	• There is a high probability that significant harm could arise to a designated receptor from an identified hazard at the site without appropriate mitigation.
High	• Significant harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate mitigation.
Medium	• It is possible that without appropriate mitigation, harm could arise to a designated receptor, but it is relatively unlikely that any such harm would be severe and if any harm were to occur, it is likely that such harm would be relatively mild.
Low	• It is possible that significant harm could arise to a designated receptor from an identified hazard, but it is likely that at worst this harm if realised would normally be mild.
Negligible	• There is a low possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.

4. Desktop Assessment

For a pollutant linkage to exist, sources, pathways and receptors must align in a manner that facilitates the transmission of a pollutant (or harm) to a receptor. The main impacts that can be imparted upon a PWS receptor is a degradation in water quality or a reduction in quantity.

Information concerning the environmental setting of the proposed development and the surrounding area which contains the PWS is presented in Chapter 9 of the EIA Report. Based on the assessment, the following conceptualisation is presented that will be used to assess potential risks to PWS.

The desktop assessment indicates the presence of two main groundwater systems; a shallow system that is largely dependent on surface water runoff and a deeper system heralding from the underlying bedrock. Shallow supplies may comprise catch pits and collection systems that obtain water over large areas which are topographically constrained. Supplies obtaining water from the underlying geology will be constrained by the nature and extent of tectonic features or fractures and be less constrained by topography. Under such circumstances, fractures will be a preferential flow pathway and may not conform to inferred surface water catchment areas. In the cases of the PWS considered, it is possible that recharge to abstraction points may be via a combination of both systems.

5. Consultation and Screening

Fifteen properties were identified within 3km of the site In May 2022, a brief questionnaire was submitted to properties requesting them to provide details on their PWS and for Natural Power to inspect their supply if required (as outlined in Section 3.2).

A response was received from the landowner of Bigholms Cottage and Bloch Farm and Bloch Steading. A response from Westwater Farm and Greenscleuch was also received. For Wauchope the resident confirmed they used a Scottish Water mains supply and did not use a PWS. For Callisterhall information was provided by the Applicant.

Table 5.1 provides a summary of the supplies with property and abstraction locations in relation to the proposed development provided in Figure 9.1 of the EIA Report.

In summary:

- Properties which were in the vicinity or shared hydrological/hydrogeological catchment of the site and/or were upstream of proposed infrastructure were scoped in for consultation and were sent a questionnaire to gain further information from the property residents on their PWS;
- All of the identified PWS abstractions were situated outside the respective 100m and 250m SEPA LUPS 31 buffers apart from Bloch Steading abstraction which is within the 250m SEPA LUPS buffer of BP North (see Figure 9.1);
- Three supplies A (Bigholms Cottage), E (Bloch Steading), I (Bloch Farm) and have been taken forward for assessment due the supply abstraction locations being located within the same hydrological catchment as the proposed development; and
- The remaining supplies were screened out from further assessment as they are not within the same hydrological or hydrogeological catchment as the proposed development.

Table 5.1: PWS Screening

Property ID	Abstraction ID	Property Name	Property Grid Reference	Abstraction Type	Abstraction Grid Reference	Nearest Infrastructure to Property / Abstraction (if known) (km)	Taken Forward to Assessment	Comments
1	A	Bigholms Cottages	NY 31149 81163	Spring	NY 30964 81094	0.77km to T6	Yes	• Landowner response confirmed spring fed and is not prone to drying up. Water is treated with a UV filter. • Taken forward for detailed assessment and site visit undertaken given proximity to proposed development and part of Back Burn catchment.
2			NY 31139 81146					
3	B	Westwater Farm	NY 30472 82287	Spring	NY 30126 82386	1.9km to T5	No	• Resident response received from Westwater Farm. Confirmed spring source, filtration and UV treatment and no known issues. Shared supply with Contractor's Yard, Big Shed (cattle/poultry), Holmfoot Cottage, Westwater Cottage and Collin Cottage. • PWS abstraction within Glentenmont Burn catchment which is not hydrologically connected to the proposed development. The B7068 and Cock Law (256m) separate the PWS from the proposed development. • No further assessment is required.
4		Holmfoot Cottage	NY 30608 81531					
5		Westwater Cottage	NY 30603 82320					
6		Collin Cottage	NY 30424 81512					
7	C	Greenscleuch	NY 30393 82629	Spring	NY 30312 82730	2.3km from T5	No	• Resident response received from Greenscleuch (Woodside). Confirmed spring on hill, no issues and not shared.

Property ID	Abstraction ID	Property Name	Property Grid Reference	Abstraction Type	Abstraction Grid Reference	Nearest Infrastructure to Property / Abstraction (if known) (km)	Taken Forward to Assessment	Comments
								• PWS abstraction within Glentenmont Burn catchment which is not hydrologically connected to the proposed development. The B7068 and Cock Law (256m) separate the PWS from the proposed development. • No further assessment is required.
8	D	Cleuchfoot Farm	NY 31440 82781	Unknown	NY 31800 83100	2.2km from T7	No	• No response received. • PWS abstraction within Logan Water catchment which is not hydrologically connected to the proposed development. The B7068 and St Bride's Hill (206m) separate the PWS from the proposed development. • No further assessment is required.
9		1 Cleuchfoot Cottage	NY 31788 82405					
10		2 Cleuchfoot Cottage	NY 31761 82396					
11	I	Bloch Farm	NY 32845 81300	Spring	NY 33362 81353	0.18km from proposed Borrow Pit North	Yes	• Resident response confirmed spring fed and is not prone to drying up. Water is treated with a UV filter. • Taken forward for detailed assessment and site visit undertaken given downgradient and proximity to proposed development.
12	F	Callisterhall	NY 28922 81615	Borehole	NY 28900 81600	1.8km from T5	No	• Information provided by the Applicant. • PWS abstraction within Pokeskine Sike catchment which is not hydrologically connected to the proposed development.

Property ID	Abstraction ID	Property Name	Property Grid Reference	Abstraction Type	Abstraction Grid Reference	Nearest Infrastructure to Property / Abstraction (if known) (km)	Taken Forward to Assessment	Comments
								The B7068 and Gowd Muir (247 m) separate the PWS from the proposed development. • No further assessment is required.
13	G	Wauchope School House	NY 32509 81706	Unknown	Not applicable	1km from proposed Borrow Pit North	No	• Resident confirmed on Scottish Water mains supply. • No further assessment is required.
14	H	Falcon Farm	NY 30747 81683	Unknown	Unknown	1.3km from T5	No	• No response received. • Property within Glentenmont Burn catchment which is hydrologically unconnected to the proposed development. The B7068 and Bigholms Hill (203m) separate the property from the proposed development. • No further assessment is required.
15	E	Bloch Steading	NY 32823 81269	Spring	NY 33098 81332	0.6km from proposed Borrow Pit North	Yes	• Resident response confirmed no issues with supply following pipe repairs and that this supply is solely for livestock and agricultural use. • Taken forward for detailed assessment and site visit undertaken given downgradient and proximity to proposed development.

6. Risk Assessment

The nature of the potential risk to the PWS abstraction is either a reduction in **water volume** or **adverse change** in the quality of the water. The purpose of this document is to provide an understanding of the PWS in the vicinity of the proposed development and the potential risk which construction may have on the quality and quantity of water serving a PWS.

Risk management techniques involve managing one or more of the components in the Source-Pathway-Receptor chain. Where practical, actual or potential pollutant linkages should be broken to eliminate the risk of a hazard impacting the receptor and where a residual risk remains, management controls and contingency arrangements should be implemented to minimise risks to an acceptable level.

6.1. Hazards

Although the construction phase of the project is short term compared to the operational phase, the risk of pollution and damage to the water environment during this phase is very high, without appropriate mitigation.

Rainfall increases the risk of pollution and damage to the surface and groundwater environment. Rainfall and associated surface water runoff during construction works can mobilise and transport pollutants such as sediment, oils, chemicals and other building materials into the surface and groundwater environment.

The key hazards acting as potential sources of pollution were identified as activities undertaken during the construction and operation of the proposed development associated with:

- Excavation of the borrow pit;
- Construction and operation of access tracks and hardstand areas;
- Wind turbine foundation excavation; and
- Creation of site compounds and laydown areas.

The completion of the construction elements listed above will require additional activities to be undertaken which may also lead to potential impacts, and these activities include:

- Surface water drainage and de-watering;
- Transport, storage and handling of fuels and oils;
- Use of machinery and plant;
- Wastewater management;
- Peat management; and
- Concrete works.

6.2. Standard Good Practice Mitigation

Standard good practise mitigation should be followed as outlined below and in Chapter 9 of the EIA Report. An outline Construction Environment Management Plan (CEMP) is included as Technical Appendix 2.1 within the EIA Report, and a detailed CEMP will be prepared post consent that evolves the mitigation presented in the following paragraphs and presented within the EIA Report. An outline Pollution Prevention Plan (PPP) (Technical Appendix 2.3) accompanies the submission of the EIA Report.

The site-specific CEMP will facilitate the implementation of industry good practice measures in such a manner as to prevent or minimise effects on the surface and groundwater environment. The CEMP will include details on the following:

- Drainage – all runoff derived from construction activities and site infrastructure will not be allowed to directly enter the natural drainage network. All runoff will be adequately treated via a suitably designed drainage scheme with appropriate sediment and pollution management measures. The proposed development is situated in an upland hydrological area and it is imperative that the drainage infrastructure is designed to accommodate storm flows based on a 1 in 200 year event plus climate change to help maintain the existing hydrological regime.
- Storage – all equipment, materials and chemicals will be stored well away from any watercourses. Chemical, fuel and oil stores will be sited on impervious bases with a secured bund at a designated location.
- Vehicles and Refuelling – the delivery, storage, transfer, handling and use of hydrocarbons often presents one of the greatest hazards sources to PWS. In addition to the good practice guidance such as:
  - Construction Industry Research and Information Association (CIRIA), 'Environmental Good Practice On Site (C650) (2005);
  - CIRIA, 'Control of Water Pollution from Construction Sites (C532)' (2001); and.
  - Fuel management will be in adherence to relevant Pollution Prevention Guidance (PPG) and Guidance for Pollution Prevention (GPP) including re-fuelling (PPG7) and storage and disposal of waste oils (GPP8). In line with the measures above, measures for bulk delivery and transfer of oils and fuels will be carried out under supervision and designated personnel will be trained in spill response measures.
- Standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Refuelling of vehicles, plant and machinery on the site will be carried out only in designated locations (which will be notified in writing to the planning authority and SEPA and may include, but need not be limited to, the construction compound) and in such a way that any spillage is contained within impermeable surfaces, and any fuel or water from such surfaces will be removed from the site and disposed of at an approved facility.
- Maintenance – maintenance to construction plant will be carried out in designated zones, on an impermeable surface well away from any watercourse or drainage, unless vehicles have broken down necessitating maintenance at the point of breakdown, where special precautions will be taken.
- Welfare Facilities – on-site welfare facilities will be adequately designed and maintained to allow the appropriate disposal of sewage. This may take the form of an on-site septic tank with soakaway, or tankering and off-site disposal depending on the suitability of the Pproposed development for a soakaway. Any discharge requirements will comply with relevant requirements issued by SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011.
- Cement and Concrete – fresh concrete and cement are very alkaline and corrosive and can be lethal to aquatic life. The use of wet concrete in and around watercourses will be avoided and carefully controlled;
- Monitoring Plan – All activities undertaken as part of the proposed development will be monitored throughout the construction phase to monitor environmental compliance.
- During the construction phase the Environmental Clerk of Works (ECoW) will carry out regular visual inspections of all receiving watercourses in conjunction with reviewing environmental mitigation controls. As a minimum, the following elements will be included in this programme:
  - Watercourses below working areas;
  - Surface water and sedimentation run-off mitigation;
  - Materials storage (fuels, oils, chemicals);
  - Contingency controls;
  - Waste management;
  - Management controls;
  - Compliance assessments (CEMP, PPP, Risk Assessment Method Statement (RAMS) etc.);
  - Emergency response and incidents; and
  - Environmental issues (litter, dust, noise etc.).

- Spill Response – a site specific Emergency Response Plan will be implemented in the unlikely event of a spill or other pollution incident. Spill kits and response materials will be available within the identified high-risk vehicles and plant working within water supply catchments and at designated locations across the construction site where hazardous materials are stored. The locations of key spill kit supply stores will be marked on a site location plan included within key documentation, which should also include a specific spill response procedure.
- Training – All relevant staff personnel will be trained in both normal operating and emergency procedures and be made aware of highly sensitive areas on site.

6.3. Additional Mitigation

6.3.1. Further Investigation & Demarcation

PWS abstraction locations and associated infrastructure can be demarcated on the ground and/or communicated to Construction personnel via the provision of detailed mapping and/or toolbox talks carried out by the Principal Contractor.

The Principal Contractor and Developer will ensure that further investigation takes place prior to construction activities taking place near the PWS and determine the location of the associated PWS infrastructure and the likelihood that the construction would impact the PWS.

6.3.2. PWS Monitoring Plan

Prior to construction a PWS Monitoring Plan and Method Statement (PWSMP) will be prepared detailing all mitigation measures to be delivered to secure the quality, quantity and continuity of water supplies to the Bigholms Cottage, Bloch Farm properties and Bloch Steading which may be affected by the proposed development.

A water level and quality monitoring programme will be undertaken prior to any construction and during construction. The method statement shall include water quality sampling methods and shall specify abstraction points. Post-construction monitoring would also be completed to ensure there is no long term impact on water quality or quantity that could be associated with the proposed development.

The PWS water monitoring programme will be aligned with the CEMP including wider surface water or groundwater monitoring programme related to the proposed development, i.e. sampling, frequency, and analysis suite (with exception to taste) are matched at the surface water monitoring locations. The document would also outline any site-specific additional mitigation outlined in this assessment relevant to each PWS.

The PWSMP will also include a pollution response plan and contingency measures that would details responsibilities and lines of communication between Principal Contractor, PWS users and other stakeholders. Contingency measures will include provisions to provide alternative water supplies on a temporary and permanent basis in the event of an unforeseen impact on the existing PWS arising from the construction and operation of the proposed development.

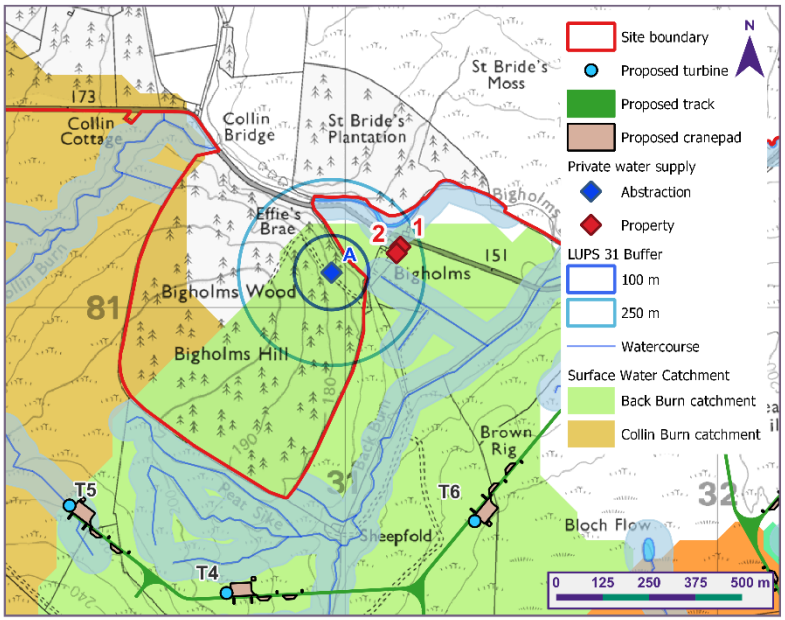
It is expected the PWSMP will be secured by condition to be imposed on the planning consent.

6.4. Risk Assessment Results

This section details the results of the risk assessment based on the methodology presented in Section 3.4. The risk assessment assumes implementation of the good practice mitigation and specific mitigation outlined above, as well as the construction management measures provided within Chapter 9 of the EIA Report.

Bigholms Cottage PWS

Proximity of abstraction to proposed development



Assessment Notes

- PWS abstraction is a collection tank situated downgradient and within a shared catchment (Back Burn) as the proposed development. Neither the property nor abstraction are within the relevant SEPA LUPS31 buffer.
- The location of the PWS delivery infrastructure between the property and abstraction is **unlikely** to be impacted by the proposed development.
- PWS user commented that the spring source water is soft and is also resilient to drought. PWS user also commented that water from tap is blue in colour and issue first noted following felling close to source a few decades ago. This could indicate higher than normal levels of copper.
- PWS abstraction is likely to be fed by a combination of shallow groundwater / overland flow from surface water catchment immediately above PWS abstraction. Given the distance, topography and land-use between the proposed development and PWS abstraction, the probability of directly pathway is considered **unlikely**.
- Whilst there could be partial dependence on bedrock groundwater (as indicated by high copper) it is noted the orientation of bedrock strata and structural features between upgradient infrastructure (T4 & T5) infers the probability of a direct pathway with proposed development is of low likelihood.

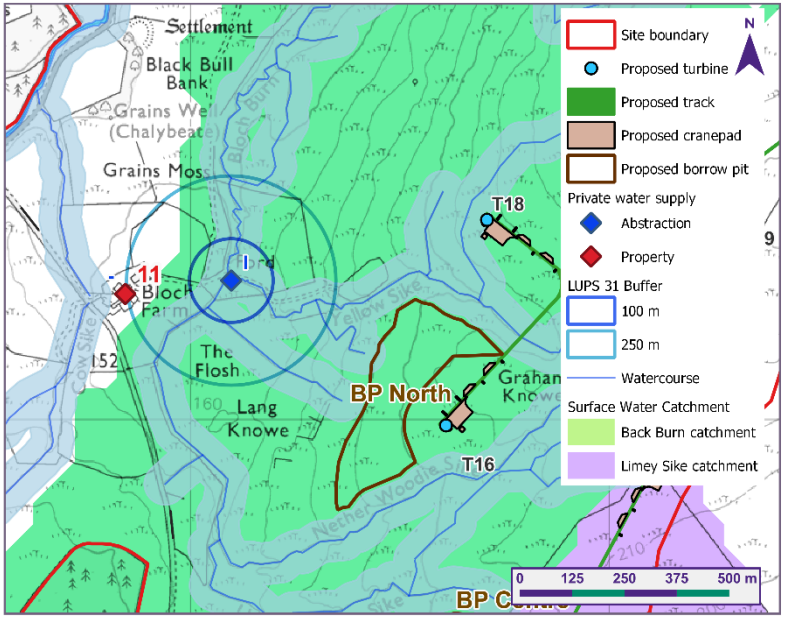
Additional Mitigation

- It is recommended that the following additional mitigation is considered;
  - Further investigation by the Principal Contractor prior to construction;
  - A programme of water quality and quantity monitoring will be developed to monitor this supply; and
  - Monitoring and management measures (including contingency) which would be outlined in PWSMP prior to construction and be based on the results of further investigation.
- The above additional mitigation would not reduce the magnitude of the effect should an unexpected incident occur, but it would reduce the likelihood of such an incident occurring. Following the completion of further assessment and more detailed consideration of the associated risk, the additional mitigation presented should be reviewed and amended (as required) to ensure it is fit for purpose.

Hazard Identification	Receptor	Probability of Impact	Magnitude of Impact	Significant of Impact	Additional Mitigation?	Revised Probability.	Residual Significance
Activities affecting water quality	All source of water serving PWS	Low Likelihood	Moderate	**Medium / Low**	Yes (above)	Unlikely	**Low**
	Pipework delivering water from PWS to Property	Unlikely	Insignificant	**Negligible**	None	-	**-**
Activities affecting water quantity	All source of water serving PWS	Low Likelihood	Insignificant	**Medium / Low**	Yes (above)	Unlikely	**Low**
	Pipework delivering water from PWS to Property	Unlikely	Insignificant	**Negligible**	None	-	**-**
Site Visit: Photographs taken on 20th July 2022.							
Site Visit Notes:	Bingholm holding tank at NY 31007 81097.Clear water. Source confirmed at NY 31003 81094. The abstracted water was noted as having a strong turquoise discolouration potentially associated with high levels of metals such as copper.						

Bloch Farm PWS

Proximity of abstraction to proposed development



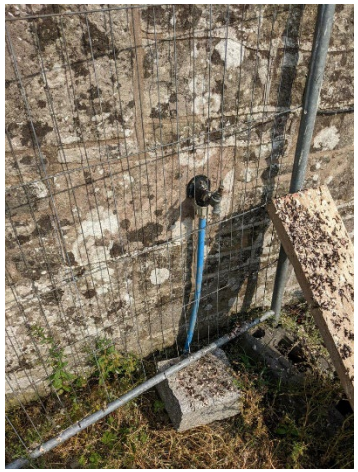
Assessment Notes

- PWS abstraction is situated downgradient and within a shared catchment (Back Burn) as the proposed development. Neither the property nor abstraction are within the relevant SEPA LUPS31 buffer.
- The PWS abstraction is a collection tank which has an inflow pipe originating from an unknown location, but suspected by the PWS user to be immediately to the south-east. PWS user also commented that the spring source water is hard and resilient to drought. The water is used for domestic and agricultural purposes.
- The water chemistry at the abstraction is moderately mineralised (309 µS/cm), and when compared to the adjacent watercourses (47 & 103 µS/cm) suggesting its more likely a spring or diffuse emergence of groundwater, probably a combination of bedrock groundwater and shallow through flow. Whilst overland flow routes from proposed developmentare likely to be limited by the density of artificial ditches, it is possible there may be a pathway via the groundwater. In the event the groundwater pathway is significant, its likely to be slightly less susceptible to change when compared to a PWS supplied entirely by a shallow, overland flow or rainfall fed system;
- The location of the PWS delivery infrastructure between the property and abstraction is **unlikely** to be impacted by the proposed development.

Additional Mitigation

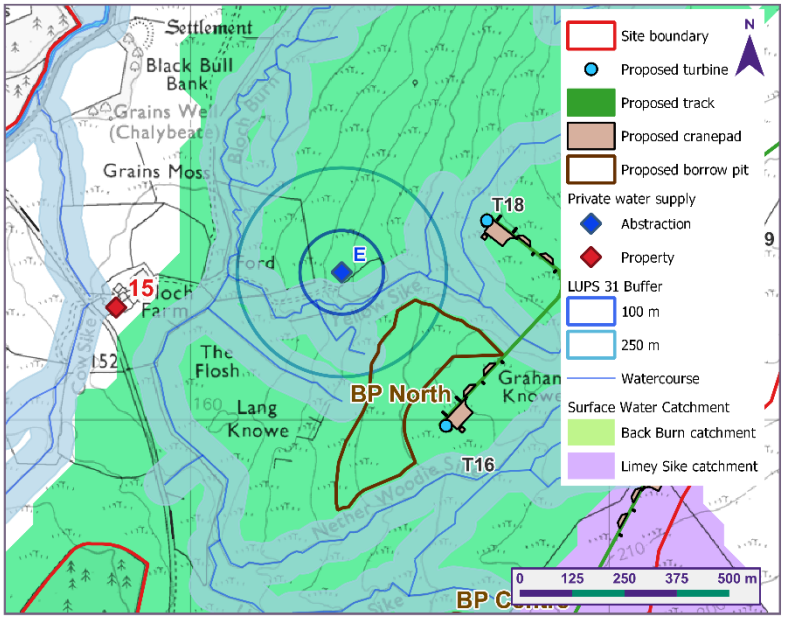
- Further investigation should be undertaken to characterise the underlying groundwater system operating within the vicinity of the PWS abstraction and the upper surface water catchment where the proposed development is situated. Notwithstanding, it is recommended that the following additional mitigation is considered;
  - Design of detailed drainage plans and specific method statements for dewatering activities to minimise water losses from the catchment and encourage infiltration;
  - Further investigation and demarcation by the Principal Contractor prior to construction;
  - No storage of fuels / oils / chemicals within the immediate PWS catchment;
  - A programme of water quality and quantity monitoring will be developed to monitor this supply; and
  - Monitoring and management measures (including contingency) which would be outlined in PWSMP prior to construction and be based on the results of further investigation.

- The above additional mitigation would not reduce the magnitude of the effect should an unexpected incident occur, but it would reduce the likelihood of such an incident occurring. Following the completion of further assessment and more detailed consideration of the associated risk, the additional mitigation presented should be reviewed and amended (as required) to ensure it is fit for purpose.

Hazard Identification	Receptor	Probability of Impact	Magnitude of Impact	Significant of Impact	Additional Mitigation?	Revised Probability.	Residual Significance
Activities affecting water quality	All source of water serving PWS	Likely	Moderate	**Medium**	Yes (above)	Low Likelihood	**Medium / Low**
	Pipework delivering water from PWS to Property	Unlikely	Insignificant	**Negligible**	None	-	-
Activities affecting water quantity	All source of water serving PWS	Likely	Moderate	**Medium**	Yes (above)	Low Likelihood	**Medium / Low**
	Pipework delivering water from PWS to Property	Unlikely	Insignificant	**Negligible**	None	-	-
Site Visit: Undertaken on 20th July and 9th September 2022.							
Site Visit Notes:	There is an outside tap at the back of the PWS Property at NY 32826 81265. A further site visit was undertaken on 9th September 2022 to further investigate the abstraction. The tank is fed by a small inlet pipe which discharges from the south-east. There is an overflow for the tank where raw water in-situ sampling was also completed (photo second from right). In-situ sampling was also undertaken for comparison purposes						

Bloch Steading PWS

Proximity of abstraction to proposed development

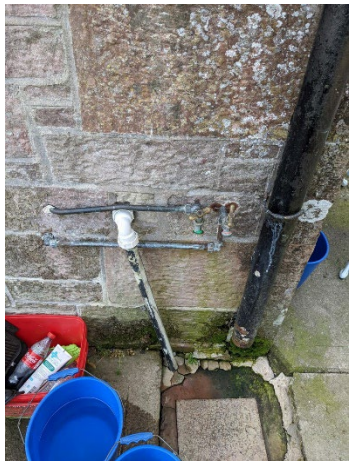


Assessment Notes

- PWS abstraction is situated downgradient and within a shared catchment (Back Burn) as proposed development and is used exclusively for livestock. The abstraction is situated within the 250m LUPS31 buffer of a borrow pit search area (BP North). It is highlighted that the final borrow pit working area will be considerably smaller than the search area, and therefore its final location may not be within the SEPA LUPS31 buffer.
- The abstraction is shallow collection chamber fed by infiltrating groundwater. The water level is noted as just below the surface. It is likely the chamber is fed by a combination of locally infiltrating surface water and shallow through flow. There may also be some nourishment by bedrock groundwater however this is unconfirmed.
- The position of Yellow Sike (minor watercourse) between the abstraction and BP North is likely to inhibit a pathway via overland flow or shallow throughflow. Infrastructure directly upgradient (T18) are outside the LUPS31 buffer and similarly intersected by more minor artificial drainage networks. None the less, the potential connectivity via shallow throughflow or bedrock groundwater remains a possibility.
- The location of the PWS delivery infrastructure between the property and abstraction is **unlikely** to be impacted by the proposed development.
- PWS User commented this water is used for agricultural purposes only and is not used as a domestic supply. Therefore, the magnitude of impact is considered to be minor.

Additional Mitigation

- Further investigation could be undertaken to characterise the underlying groundwater system operating within the vicinity of the PWS abstraction and the upper surface water catchment where the proposed development is situated. This would allow for more appropriate mitigation to be designed. Notwithstanding, it is recommended that at a minimum the following additional mitigation is considered;
  - Design of detailed drainage plans and specific method statements for dewatering activities to minimise water losses from the catchment and encourage infiltration;
  - No storage of fuels / oils / chemicals within the immediate PWS catchment. This should include refuelling activities;
  - A programme of water quality and quantity monitoring will be developed to monitor this supply; and
  - Monitoring and management measures (including contingency) which would be outlined in PWSMP prior to construction and be based on the results of further investigation.

Hazard Identification	Receptor	Probability of Impact	Magnitude of Impact	Significant of Impact	Additional Mitigation?	Revised Probability	Residual Significance
Activities affecting water quality	All source of water serving PWS	Likely	Minor	**Medium / Low**	Yes (above)	Low Likelihood	**Low**
	Pipework delivering water from PWS to Property	Unlikely	Insignificant	**Negligible**	None	-	**-**
Activities affecting water quantity	All source of water serving PWS	Likely	Minor	**Medium / Low**	Yes (above)	Low Likelihood	**Low**
	Pipework delivering water from PWS to Property	Unlikely	Insignificant	**Negligible**	None	-	**-**
Site Visit: Photographs taken on 20th July 2022.							
Site Visit Notes:	Bloch Steading source confirmed as shallow collection chamber. Steading tap NY 32820 81277 at front of Bloch Farmhouse (green tap). Bloch Steading holding tank at NY 33364 81346.						

7. Conclusions

A PWSRA has been carried out for PWS that may be affected during the construction and operation of the proposed development. The formation of this report has included a desk review of baseline information as well as data returns provided by DGC on identified PWS within a 3km buffer of the site, consultation with selected residents, Ordnance Survey mapping data and selected site visits.

The risk assessment was undertaken using the Source-Pathway-Receptor model to establish the likelihood of a potential pollutant linkage existing between the proposed development and the supply of the identified PWS. Factors taken into consideration in the risk assessment include the proximity of the proposed development to the PWS source, layout of PWS infrastructure and pipework, the type of works being undertaken, the likely presence of pathways between the development and the source, the local topographic conditions and the underlying geology.

The PWS has been evaluated based on the information provided to determine the risks based on the prescribed matrix scenarios. To minimise the risk of the proposed development construction activities potentially impacting any PWS supply, mitigation measures have been outlined which will be implemented by the Principal Contractor.

Standard good practice mitigation has been outlined in Section 4.2 of this assessment and will be included within a CEMP which will be prepared prior to construction. In addition to this mitigation, a PWSMP will be prepared prior to construction and will detail all relevant mitigation, management measures, monitoring requirements and contingency plans relevant to PWS considered within this assessment and those listed in Chapter 9 of the EIA Report. This includes supply protection measures required for and for Bigholms Cottage, Bloch Farm and Bloch Steading.

The qualitative assessment has identified uncertainty in the risk assessment associated with the potential influence of structural features within the bedrock to transmit hazards associated with the proposed development to PWS. Further investigation will be undertaken as part of the pre commencement detailed design process to determine the potential risk more accurately for a pollutant linkage to exist between these PWS and the proposed development via this pathway. The results of the investigation will identify the detailed requirement for any mitigation.

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